

# Analysis Report Honey-Profiling™

Sample ID: 230724015

**Information/Declaration provided by customer:**

Customer: **Callaghan**  
 Customer Sample ID: FSH-QC1-2022  
 Type of Sample: Honey  
 Type of Honey: Blossom  
 Botanical Variety: Manuka  
 Geographical Origin: New Zealand  
 Information: tube12

*Disclaimer: this information will affect the applicability and validity of analyses and results.*

*Note: it is important to fill in these information in a correct and precise manner (e.g. variety in case of monofloral honey, and country of origin). The tests applied (and therefore the results received) are different from one type of honey to the other. Bruker does not take responsibility for wrong or incomplete information given by the customer.*

Measuring Date: 24-Jul-2023 11:21:50  
 Reporting Date: 24-Jul-2023 13:36:32, 14 pages, Version 3.1.2

**Results Summary**

Type of Analysis	Result	Status
<b>Origin, Type and Variety</b>		
Botanical Variety: Manuka	Consistent	●
Country of Origin: New Zealand	Consistent	●
<b>Test of Markers of Foreign Sugars</b>	Pass	●
<b>Composition and Comparison to Reference Group</b>	Requires Interpretation	●
<b>Compliance for EU Market for</b>		
HMF	Compliant	●
Sucrose	Compliant	●
Glucose + Fructose	Compliant	●

The data analysis is performed at Bruker BioSpin GmbH (Ettlingen, Germany) according to testing method AA-72-03-17 (Honey-Profiling 3.1.2), released on 09-May-2023 (DIN EN ISO/IEC 17025:2018 Accreditation Certificate D-PL-19229-01-00). All results solely refer to the tested sample as provided by the customer.

## Origin, Type and Variety

### Botanical Variety: Manuka

(Analysis-ID: HS3-CC-008-18146)

### Concentration of 3-phenyllactic acid:

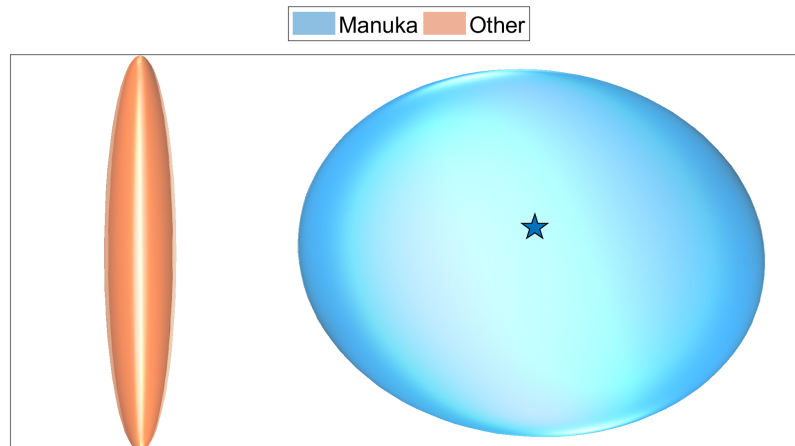
Compound	Value	Unit	LOQ	Flag
3-phenyllactic acid	662	mg/kg	300	●

The concentration of 3-phenyllactic acid is typical for monofloral Manuka honeys (exceeding 400mg/kg) but this parameter alone is not sufficient to verify that the sample is consistent with monofloral Manuka honey. The NMR profile needs to be checked as well for confirmation.

### Statistical Model:

This model is based on 27326 samples, thereof 210 samples of reference group *Manuka*.

**Result:** Consistent with declared variety *Manuka*. The probability of consistency is 100.0%.

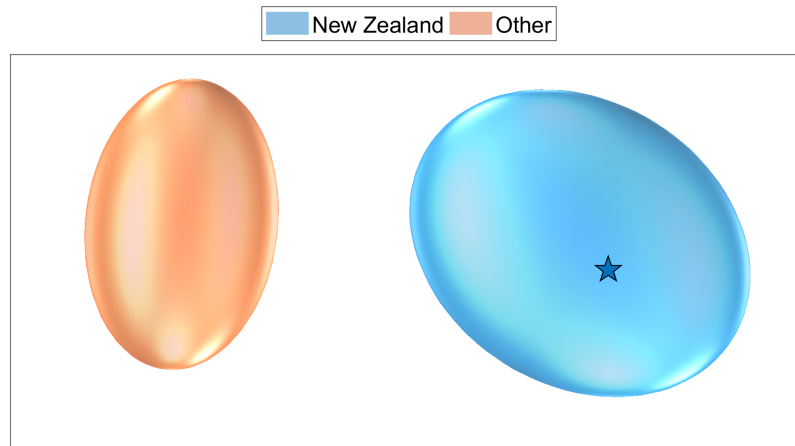


## Country of Origin: New Zealand

(Analysis-ID: HS3-CC-113-18149)

This model is based on 24953 samples, thereof 478 samples of reference group *New Zealand*.








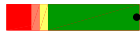



























**Result:** Consistent with declared country *New Zealand*. The probability of consistency is 100.0%.








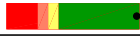





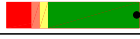



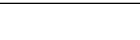



## Test of Markers of Foreign Sugars

(Analysis-ID: HO-TAD-01/0833)

Following tests have been applied in order to detect foreign sugars:

ID	Description	Value	Graphics	Result
2	3.8113 / (1.95-2.02)	16.46		pass
3	3.9238 / (3.16-4.14)	0.0004912		pass
4	3.2890 / (1.95-2.02)	1.676		pass
5	4.0363 / (3.75-3.80)	0.00524		pass
6	5.3324 / (5.27-5.30)	0.0988		pass
7	3.0123 / (1.95-2.02)	0.01354		pass
8	3.5929	727		pass
9	5.0745 / (4.07-4.12)	0.004160		pass
10	3.2753	222.4		pass
11	3.7490 / (1.95-2.02)	0.28		pass
13	4.1961 / (3.16-4.14)	0.0000965		pass
14	3.3135 / (5.27-5.30)	0.0352		pass
15	4.6809 / (3.65-3.73)	0.00019945		pass
16	3.7715 / (3.65-3.73)	0.05001		pass
17	5.4913 / (4.60-4.67)	0.001921		pass
18	4.6327 / (3.16-4.14)	0.0004481		pass
19	4.2569 / (1.95-2.02)	0.0429		pass
20	3.2797	156.4		pass
25	3.5477	3884		pass
26	4.0281 / (4.07-4.12)	0.05422		pass
127	4.2487	70.7		pass
128	5.3045 / (1.95-2.02)	0.1696		pass
129	3.5884 / (3.75-3.80)	0.002623		pass
130	4.9421 / (4.93-4.97)	0.1476		pass
131	3.5929 / (4.07-4.12)	0.00552		pass
133	4.9433 / (4.93-4.97)	0.07217		pass
134	4.2501	29.5		pass
135	3.9156 / (4.07-4.12)	0.03017		pass
136	5.2876 / (4.07-4.12)	0.001878		pass
140	3.2852 / (4.07-4.12)	0.004677		pass
142	4.3176 / (5.27-5.30)	0.03081		pass
143	5.3371 / (5.27-5.30)	0.02316		pass
144	4.4347 / (4.07-4.12)	0.0004177		pass
155	4.1511	524.7		pass
156	3.3701 / (3.20-3.22)	0.08736		pass

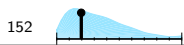
ID	Description	Value	Graphics	Result
157	4.1781 / (4.07-4.12)	0.0008622		pass
158	3.9283 / (5.27-5.30)	0.1410		pass
159	3.9246 / (5.20-5.25)	0.02263		pass
162	3.1784 / (5.20-5.25)	0.003850		pass
163	3.5929 / (3.16-4.14)	0.0002702		pass
166	3.6627 / (4.07-4.12)	0.02644		pass
167	3.2977 / (4.07-4.12)	0.003017		pass
168	3.3753 / (4.60-4.67)	0.1648		pass
169	3.7579 / (3.65-3.73)	0.12019		pass
170	3.8885 / (3.75-3.80)	0.05042		pass
171	4.1651 / (1.95-2.02)	2.222		pass
172	3.1637	23.449		pass
191	3.7932 / (4.07-4.12)	0.2287		pass
1000	min. fructose/glucose	1.24		pass
1001	max. fructose/glucose	1.24		pass
1002	turanose [g/100g]	1.26		pass
1003	sucrose [g/100g]	0.2		pass
1004	total sugar [g/100g]	73.2		pass
1005	proline [mg/kg]	455		pass
1006	DHA(D), mannose(M) [mg/kg]	D=722.7, M=76		pass

**Result:** There are no indications for the presence of foreign sugars.

**Notes:**

- The column *ID* is the marker's identification number.
- The column *Description* indicates either the NMR spectral region(s) (in ppm) concerned by the marker, or the molecule when it has been identified.
- The column *Value* is the result obtained for the marker.
- For columns *Graphics* and *Result* please refer to detailed description in section "General Remarks" at the end of this report.

## DHA and Mannose

Compound	Value	Unit	LOQ	Reference Range	Flag
mannose	<LOQ	g/100g	0.02	<0.02 g/100g in reference dataset	●
dihydroxyacetone (DHA)	723	mg/kg	5		●

Note: the reference range is based on *166 Manuka* samples in the Honey-Profiling Database.

### Guideline:

- Mannose is a mono saccharide not found in honeys with a pH value lower than 5, but that is regularly found in industrial sugars. In rare cases, however, the presence of mannose cannot be excluded for certain geographic origins and/or botanical varieties. A concentration of mannose exceeding 0.02 g/100g in honey with a pH < 5 could indicate the presence of foreign sugars or industrial processing practices which are not suitable for honey. An expert interpretation is suggested when mannose is present in the honey.
- Dihydroxyacetone and/or methylglyoxal are only known to be naturally present in *Leptospermum* genus honeys from Australia and New Zealand. A concentration exceeding 5 mg/kg in other types of honey is not typical and could indicate the presence of foreign sugars or industrial processing practices which are not suitable for honey. An expert interpretation is suggested in such cases.
- DHA and mannose are often observed simultaneously in various types of sugar syrups.

Deviations in the sugar profile, fermentation parameters and comparison to reference group could also indicate adulterations. Please check the section "Composition and Comparison to reference group" in addition.



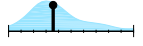





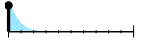



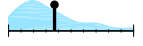





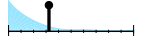

## Composition and Comparison to Reference Group

### Quantitative Analysis of Compounds






(Analysis-ID: HO-Q/3.1.0)

Parameters labelled with \* are calculated parameters. The reference range is based on *166 Manuka* samples in the Honey-Profiling Database.

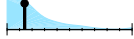
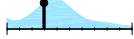

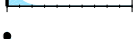

#### Sugars:

Compound	Value	Unit	LOQ	Reference Range	Flag
glucose + fructose *	73.2	g/100g	20.0	65.5  79.2	
fructose / glucose *	1.24	-	-	1.09  1.52	
fructose	40.6	g/100g	10.0	36.6  46.4	
glucose	32.7	g/100g	10.0	28.5  37.1	
sucrose	<LOQ	g/100g	0.5	<0.5  1.2	
turanose	1.26	g/100g	0.2	0.5  2.0	
maltose	1.3	g/100g	0.5	0.6  2.4	
melezitose	<LOQ	g/100g	1.0	<1.0  2.5	
maltotriose	<LOQ	g/100g	1.0	<1.0 g/100g in reference dataset	
gentiobiose	<LOQ	g/100g	0.3	<0.3 g/100g in reference dataset	
raffinose	0.3	g/100g	0.1	0.1  0.7	

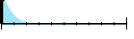






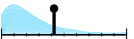

#### Acids:

Compound	Value	Unit	LOQ	Reference Range	Flag
citric acid	163	mg/kg	50	56  293	
malic acid	<LOQ	mg/kg	100	<100  358	
quinic acid	<LOQ	mg/kg	300	<300 mg/kg in reference dataset	

**Amino Acids:**

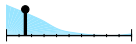

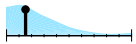


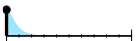

Compound	Value	Unit	LOQ	Reference Range	Flag
alanine	8	mg/kg	5	<5  27	●
aspartic acid	<LOQ	mg/kg	150	<150 mg/kg in reference dataset	●
glutamine	<LOQ	mg/kg	200	<200 mg/kg in reference dataset	●
leucine	<LOQ	mg/kg	40	<40 mg/kg in reference dataset	●
proline	455	mg/kg	150	261  917	●
valine	<LOQ	mg/kg	10	<10  16	●
tyrosine	<LOQ	mg/kg	50	<50  97	●
phenylalanine	<LOQ	mg/kg	100	<100  600	●

**Indicators for Fermentation and Processing:**

Compound	Value	Unit	LOQ	Reference Range	Flag
2,3-butanediol	<LOQ	mg/kg	20	<20  37	●
5-hydroxymethylfurfural (HMF)	16	mg/kg	5	<5  48	●
acetic acid	23	mg/kg	10	<10  121	●
acetoin	<LOQ	mg/kg	20	<20 mg/kg in reference dataset	●
ethanol	69	mg/kg	5	7  1420	●
lactic acid	61	mg/kg	10	24  225	●
formic acid	109	mg/kg	5	23  190	●
fumaric acid	5	mg/kg	5	<5  10	●
pyruvic acid	32	mg/kg	10	15  142	●
succinic acid	33	mg/kg	5	6  71	●



**Markers:**

Compound	Value	Unit	LOQ	Reference Range	Flag
3-phenyllactic acid	662	mg/kg	300	372  2300	
methylglyoxal (MGO)	320	mg/kg	30	110  1486	
kynurenic acid	<LOQ	mg/kg	60	<60 mg/kg in reference dataset	
shikimic acid	<LOQ	mg/kg	80	<80  91	

**Guideline:**

- Values of fructose/glucose ratio exceeding 1.95 or below 0.85 are not typical for honey and could indicate the presence of sugar syrups.
- Low concentrations of turanose (less than 0.35 g/100g) is a marker for the presence of foreign sugars (see section "Markers of Foreign Sugars").
- Atypical concentrations of sugars in comparison to reference range can be related to foreign sugars/adulteration or to the botanical varieties present in the honey. Expert interpretation is suggested.
- The presence of gentiobiose is common for Linden Tree honey.
- The presence of quinic acid is common for honeydew.
- HMF is a sugar degradation product formed under influence of heat. According to EU-Directive (2001/110/EC), HMF can be found naturally in honey in concentrations up to 80 mg/kg in regions with tropical climate. A higher concentration of HMF is due to processing of honey which can sometime correlate with adulterations. A concentration of HMF exceeding 200 mg/kg should be regarded as suspicious.
- Concentration of ethanol exceeding 400 mg/kg indicates fermentation of the honey, which could be related to unripe honey.
- Acetoin can be elevated in Eucalyptus honey.
- The presence of kynurenic acid is common for Chestnut honey.
- The presence of shikimic acid is common for honeydew.

## Statistical Comparison with the Reference Group

The models are based on 166 *Manuka* samples in the Honey-Profiling Database.

### Univariate Verification

(Analysis-ID: HS3-NTV-008-18152)

**Applied Model:** Manuka

**Result:** Not typical for Manuka.

1.264<sup>high</sup> 1.268<sup>high</sup> 1.273<sup>high</sup>

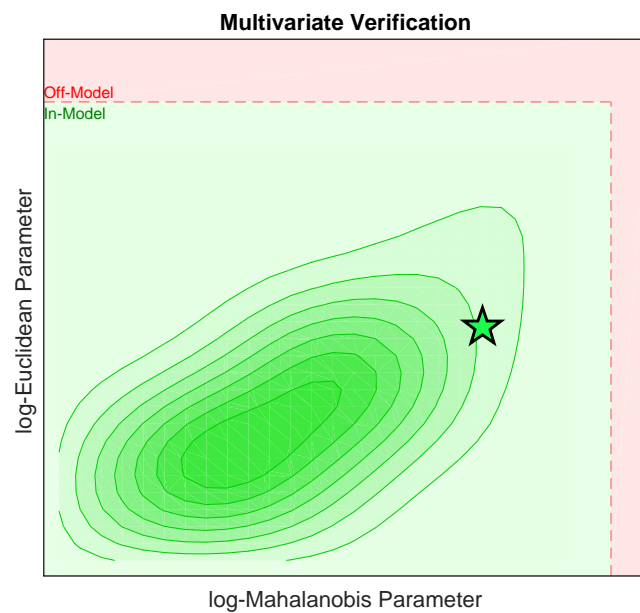
The suffix *high* indicates that the intensity is higher than in the reference group, the suffix *low* indicates that the intensity is lower than in the reference group.

### Multivariate Verification

(Analysis-ID: HS3-NTV-008-18152)

**Applied Model:** Manuka

**Result:** Typical for Manuka.



## Codex Alimentarius and EU-Directive 2001/110/EC:

Following parameters are required according to Codex Alimentarius and EU-Directive 2001/110/EC. The concentrations are obtained by direct quantification. Parameters labelled with \* are calculated parameters.

Compound	Value	Unit	LOQ	Official Reference		
				min	max	Flag
glucose + fructose *	73.2	g/100g	20.0	60	-	●
sucrose	<LOQ	g/100g	0.5	-	15	●
5-hydroxymethylfurfural (HMF)	16	mg/kg	5	-	80	●

Following flags are used according to Codex Alimentarius and EU-Directive 2001/110/EC:

Compound	Flag	Concentration	Declaration	Interpretation
glucose + fructose	●	< 45 g/100g	All	Not compliant
		< 60 g/100g	Blossom	Not compliant for blossom honey
	●	≥ 60 g/100g	All	Compliant
	●	≥ 45 g/100g	Honeydew	Compliant for honeydew honey
sucrose	●	≥ 45 g/100g, < 60 g/100g	Unknown	Compliant for honeydew honey and blends of honeydew honey with blossom honey. Not compliant for blossom honey.
	●	> 15 g/100g	All	Not compliant
		10-15 g/100g	Acacia, Eucalyptus	Not compliant for false acacia ( <i>Robinia pseudoacacia</i> ), and red gum ( <i>Eucalyptus camadulensis</i> )
	●	≤ 5 g/100g ≤ 10 g/100g	All Acacia, Eucalyptus	Compliant Compliant for false acacia ( <i>Robinia pseudoacacia</i> ), and red gum ( <i>Eucalyptus camadulensis</i> )
HMF	●	≤ 15 g/100g 5-10 g/100g	Lavender All, except Acacia, Eucalyptus, Lavender	Compliant for <i>Lavandula spp.</i> If ≤ 15g/100g: compliant for lavender ( <i>Lavandula spp.</i> ) and borage ( <i>Borago officinalis</i> ). If ≤ 10g/100g: compliant for false acacia ( <i>Robinia pseudoacacia</i> ), alfalfa ( <i>Medicago sativa</i> ), Menzies Banksia ( <i>Banksia menziesii</i> ), French honeysuckle ( <i>Hedysarum</i> ), red gum ( <i>Eucalyptus camadulensis</i> ), leatherwood ( <i>Eucryphia lucida</i> , <i>Eucryphia milliganii</i> ) and <i>Citrus spp.</i>
	●	> 80 mg/kg	All, except Industrial honey	Not compliant, except for baker's honey
HMF	●	≤ 40 mg/kg	All	Compliant
		> 80 mg/kg	Industrial honey	Compliant for baker's honey
	●	40-80 mg/kg	All	Not compliant, except for baker's honey and honeys of declared origin from regions with tropical climate and blends of these honeys

## General Remarks

### Targeted Markers for Foreign Sugars

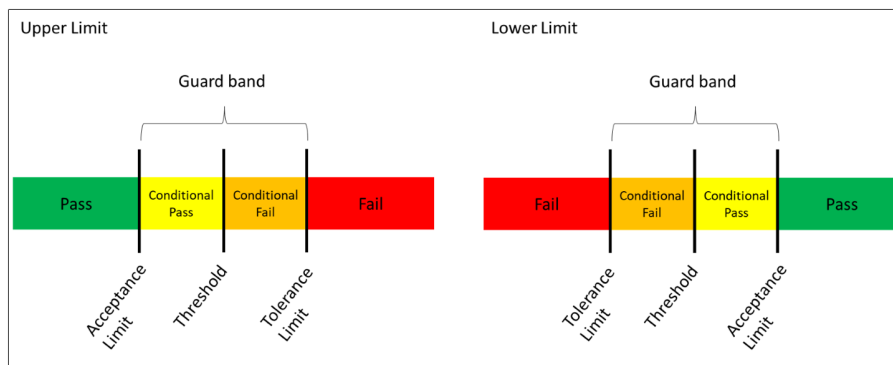
This test aims at detecting foreign sugars. It does rely on the analysis of the concentrations of certain known molecules and on absolute intensities or intensities ratios of marker peaks. The Honey-Profiling report contains several tens of markers. Some of these markers are independent on the variety and the origin, in order to be able to analyze blends, while there are also many markers specific to countries or varieties.

The values obtained for each marker are compared to the thresholds for purity.

Reported and visualized results:

- Result Pass (green):**  
 Markers with an upper limit: The value of the marker is below the acceptance limit  
 Markers with a lower limit: The value of the marker is above the acceptance limit  
 Conclusion: There are no indications for the presence of foreign sugars.
- Result Conditional Pass (yellow):**  
 The value of the marker is between the acceptance limit and the threshold  
 Conclusion: There is no indication for the presence of foreign sugars. However, for one or more markers the determined values are close to the threshold.
- Result Conditional Fail (orange):**  
 The value of the marker is between the threshold and the tolerance limit  
 Conclusion: There is a strong indication for the presence of foreign sugars. However, the determined values are close to the threshold. It is recommended to perform additional tests in order to better evaluate the risk.
- Result Fail (red)**  
 Markers with an upper limit: The value of the marker is above the tolerance limit  
 Markers with a lower limit: The value of the marker is below the tolerance limit  
 Conclusion: There is a strong indication for the presence of foreign sugars.

The black dot represents the current sample.



Presence of foreign sugars is due to deliberate dilution of honey with sugar syrups or wrong beekeeping practices in terms of artificial feeding of bees.

All conformity statements in this section are based on the "Non Binary Statement with Guard Band" according to ILAC G8:09/2019. Please find in the following table the values for acceptance limit (conditional pass), threshold (conditional fail) and tolerance limit (fail).

ID	Description	Conditional Pass	Conditional Fail	Fail
2	3.8113 / (1.95-2.02)	>68.95	>69.44	>69.92
3	3.9238 / (3.16-4.14)	<0.0003172	<0.0003039	<0.0002905
4	3.2890 / (1.95-2.02)	>5.792	>5.838	>5.884
5	4.0363 / (3.75-3.80)	>0.01113	>0.01131	>0.01148
6	5.3324 / (5.27-5.30)	>0.1683	>0.1703	>0.1723
7	3.0123 / (1.95-2.02)	>0.06929	>0.07134	>0.07340

ID	Description	Conditional Pass	Conditional Fail	Fail
8	3.5929	>2186	>2227	>2269
9	5.0745 / (4.07-4.12)	<0.001662	<0.001495	<0.001329
10	3.2753	>407.8	>414.9	>422.0
11	3.7490 / (1.95-2.02)	>11.53	>11.56	>11.59
13	4.1961 / (3.16-4.14)	>0.0002284	>0.0002327	>0.0002369
14	3.3135 / (5.27-5.30)	>0.1677	>0.1717	>0.1757
15	4.6809 / (3.65-3.73)	<0.00009264	<0.00008224	<0.00007184
16	3.7715 / (3.65-3.73)	>0.06283	>0.06399	>0.06515
17	5.4913 / (4.60-4.67)	>0.002301	>0.002341	>0.002380
18	4.6327 / (3.16-4.14)	<0.0003476	<0.0003379	<0.0003282
19	4.2569 / (1.95-2.02)	>0.7715	>0.7759	>0.7803
20	3.2797	>262.1	>268.0	>273.9
25	3.5477	<3341	<3188	<3035
26	4.0281 / (4.07-4.12)	>0.08157	>0.08631	>0.09105
127	4.2487	>366.4	>382.3	>398.2
128	5.3045 / (1.95-2.02)	>0.6017	>0.6092	>0.6168
129	3.5884 / (3.75-3.80)	>0.006261	>0.006470	>0.006679
130	4.9421 / (4.93-4.97)	>0.1832	>0.1862	>0.1892
131	3.5929 / (4.07-4.12)	>0.01423	>0.01446	>0.01470
133	4.9433 / (4.93-4.97)	>0.08613	>0.08758	>0.08904
134	4.2501	>237.5	>244.2	>251.0
135	3.9156 / (4.07-4.12)	<0.02216	<0.02141	<0.02065
136	5.2876 / (4.07-4.12)	>0.004380	>0.004442	>0.004505
140	3.2852 / (4.07-4.12)	>0.008687	>0.008959	>0.009231
142	4.3176 / (5.27-5.30)	>0.07307	>0.07400	>0.07494
143	5.3371 / (5.27-5.30)	>0.04644	>0.04885	>0.05127
144	4.4347 / (4.07-4.12)	<0.0001627	<0.0001543	<0.0001460
155	4.1511	<307.6	<268.2	<228.8
156	3.3701 / (3.20-3.22)	<0.07742	<0.07561	<0.07380
157	4.1781 / (4.07-4.12)	<0.0004571	<0.0003843	<0.0003115
158	3.9283 / (5.27-5.30)	>0.4156	>0.4226	>0.4295
159	3.9246 / (5.20-5.25)	<0.01303	<0.01167	<0.01031
162	3.1784 / (5.20-5.25)	<0.002753	<0.002590	<0.002427
163	3.5929 / (3.16-4.14)	>0.0008186	>0.0008317	>0.0008449
166	3.6627 / (4.07-4.12)	<0.02052	<0.02000	<0.01949
167	3.2977 / (4.07-4.12)	<0.002394	<0.002260	<0.002126
168	3.3753 / (4.60-4.67)	>0.1892	>0.1935	>0.1977
169	3.7579 / (3.65-3.73)	<0.08739	<0.08315	<0.07891
170	3.8885 / (3.75-3.80)	<0.03880	<0.03725	<0.03570
171	4.1651 / (1.95-2.02)	>6.362	>6.421	>6.480
172	3.1637	<10.563	<8.554	<6.544
191	3.7932 / (4.07-4.12)	>0.3806	>0.3999	>0.4192
1000	min. fructose/glucose	<0.90	<0.85	<0.80
1001	max. fructose/glucose	>1.90	>1.95	>2.00
1002	turanose [g/100g]	<0.38	<0.35	<0.32
1003	sucrose [g/100g]	>14	>15	>16
1004	total sugar [g/100g]	<46	<45	<44
1005	proline [mg/kg]	<171	<160	<149
1006	DHA(D), mannose(M) [mg/kg]	D>3, M>150	D>5, M>200	D>7, M>250

### Classification Models

Analysis of origin, type and variety relies on a statistical classification analysis. The test applied is a classification analysis with the aim to check the consistency of the declared meta-information of the sample (geographical origin or botanical variety). The consistency with a group is expressed as posterior probability in the range from 0% to 100%. A posterior probability exceeding 50% is being regarded as consistent with the respective group. The underlying statistical models are based on a dimension reduction (Principal Component Analysis and/or Linear Discriminant Analysis used) followed by a Linear (or Quadratic) Discriminant Analysis for final classification.

Within the discrimination space figure, the ellipsoids are representing the modeling samples and the star represents the

actual sample under investigation.

Verification of origin is not possible on blends from different countries.

Expert interpretation is necessary before deducing any conclusions.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

#### Quantitative Analysis

Quantitative values are compared with the distribution of concentration of the reference samples in the Honey-Profiling Database, for the same type of honey. Deviations to the reference range can be linked with adulterations or with specificities of the honey (e.g. untypical floral/ plant sources or production regions). For this reason, an expert interpretation is suggested in case of deviations.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

#### Univariate and Multivariate Verification Models

Verification models are non-targeted analyses comparing the whole NMR-Profile of a specific sample with one corresponding group of reference spectra (within the Honey-Profiling Database). All spectral data points are taken into account irrespective of whether the signals are caused by already identified molecules or not.

In the univariate analysis, the NMR spectrum is checked for any unusual low or high signal intensities, while taking into account the natural variability of a respective reference group. The chemical shifts (positions of the signals in the spectra) of the deviating signals are indicated. A guideline gives a list of possible molecules with their chemical shifts that could be responsible for the deviations.

The multivariate models take into account the relation between different signals in the NMR spectrum.

Deviations to the group of reference spectra can be linked with adulterations or specificities of the honey (e.g. untypical floral/ plant sources or production regions). For this reason, an expert interpretation is suggested in case of deviations.

All conformity statements in this section are based on the "Binary Statement for Simple Acceptance Rule" according to ILAC-G8:09/2019.

#### FAQ - Frequently asked Questions

For more information please visit our website and read our FAQ at

<http://www.bruker.com/en/products-and-solutions/mr/nmr-food-solutions/honey-profiling/honey-profiling-faq.html>

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**END OF REPORT**